Foraging Behavior of *Trigona fulviventris* in Costa Rica

(Hymenoptera: Apidae)

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A colony of the stingless bee *Trigona fulviventris fulviventris* Guérin was observed during the dry season between 8 and 12 March 1969, at The Tropical Science Center field station, about four km southwest of Rincon de Osa, Puntarenas Province, Costa Rica. Observations centered around a nest of *T. fulviventris* at the hollow base of a large, buttressed tree one m from the bank of the Rio Agua Buena. The entrance tube projected between two buttresses, about 20 cm above the ground surface.

The diurnal activity cycle of *T. fulviventris* was determined by sampling the numbers of bees leaving and entering the nest on 10 March. Six one minute counts, three of bees leaving and three of bees entering the nest entrance tube, were made at hourly intervals from 0552 until 1750 (sunrise, 0540, sunset, 1741), with one series of counts being made on the half hour around 1730. The bees were also observed at the hive before sunrise on 11 March. Other aspects of *T. fulviventris* behavior, as well as the behavior of other stingless bees, were observed and recorded at the nest site and elsewhere in the study area. Additionally, eight cardboard feeding stations were placed on trees at varying distances from 5 to 100 m and in various directions from the study nest. These stations were baited with 50% honey solution and checked for bees at regular intervals.

Results.—The diurnal activity cycle of *T. fulviventris* was recorded as departure and return rates per minute from the study nest (Fig. 1). The first observed activity was at 0523 on 11 March (sunrise 0540) when bees, observed by flashlight, were clustered at the lip of the mud nest entrance. Individual bees would leave the cluster and fly toward the flashlight beam at that time, but natural departure from the nest did not appear to have begun. Bees could be seen in the dim light at 0535 to be leaving the nest in great numbers. A few were returning. By 0550 large numbers of bees were both leaving and returning to the nest.

The greatest activity period of *T. fulviventris* was in the morning hours from the onset of activity at about 0530 until about 1000, during

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The Pan-Pacific Entomologist 49: 21–25. January 1973

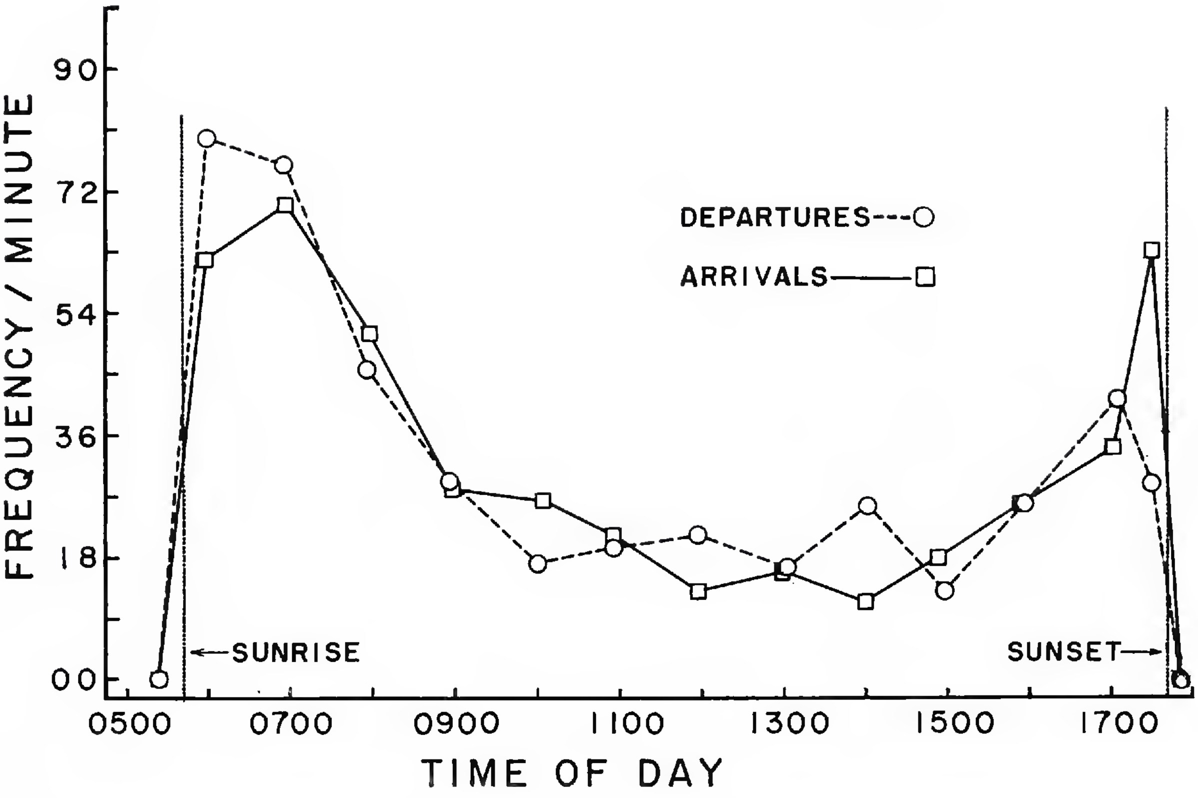

Fig. 1. Diurnal activity pattern of *Trigona fulviventris* leaving and returning to a nest on the Osa Peninsula, Puntarenas Province, Costa Rica, on 10 March 1969.

which time departures fell from about 80/min to about 20/min (Fig. 1). The lower activity level was maintained until after 1500, when activity began to rise to a second peak of about 40 departures/min at 1700. Beyond this time departure rate decreased rapidly, and arrival rate increased, until by 1750 (sunset, 1741) all departure and arrival activity had ceased.

Pollen carrying activity was greatest in the early morning hours, when an estimated 50% of the returnees carried pollen. Only an occasional bee returned with pollen in the afternoon.

The flight of *T. fulviventris* was very rapid and direct in leaving and returning to the nest tube. At other times, however, individuals could be found hovering low over the ground, occasionally alighting, usually around tree bases or stumps. Bees were also observed to hover near feeders at times, while not alighting on the feeding boards. Hovering of *T. fulviventris* was noticed at all times of day, and was usually the only activity noticed in bees of this species found away from the study nest. No stingless bee species other than *T. fulviventris* was observed hovering in such a manner, although at least three other species were commonly seen in the study area.

Trigona fulviventris failed to forage at any of the several feeding stations established around the study nest from 8 to 10 March. In separate observations made on 7 March, however, in an area approximately 300 m upstream from the nest site, *T. fulviventris* foraged in small numbers at three feeding stations similar to the ones used in the study. As many as three individuals were seen at one time on a feeder. It was not known whether or not these individuals originated from the observed nest.

All observations of *T. fulviventris* were made during fair weather under non-overcast skies.

DISCUSSION.—The absence of *T. fulviventris* at honey-baited feeding stations at varying distances from the study nest is surprising considering that the species visits many different kinds of flowers (Schwarz, 1948, p. 333) and makes honey. The situation seems all the more strange because some feeding stations treated on 7 March similarly to those around the study nest, but placed in a different part of the forest, attracted a small number of *T. fulviventris* within a few hours. Possibly individuals of *T. fulviventris* from a given nest do not establish at food sources near to that nest. This possibility is supported by Michener (1946, p. 181) who states "At old Panama *T. fulviventris* was never seen visiting flowers of herbaceous plants growing near its nest although these same plants were visited regularly by *T. jaty* and *T. nigra paupera.*"

Observations on 11 March indicated that *T. fulviventris* began to leave the nest naturally under light intensities so low that departures could not be detected without a flashlight. How the bees could navigate at these times, when visual cues were apparently unavailable, and before scent trails could have been laid for that day, is unknown.

Early flight activity appears to be characteristic of other *Trigona* species. Schlising (1970) for example, studied morning foraging of bees on four species of plants in three different areas in Costa Rica during the dry season. At each site *Trigona* bees, foraging in large numbers on two plant species, were the earliest bees to arrive after it was light. Only bees of the genus *Ptiloglossa* (Colletidae), which often foraged before light, were earlier. Schwarz (1948, p. 83) cites instances of a *Trigona* species of the subgenus *Partamona* being active before sunrise, although he states that this activity might have resulted from disturbance of the nest. Peckolt (1894) found that in Brazil the stingless bees *Trigona jatay*, *T. bipunctata*, and *T. mosquito* (all reported as *Melipona*) showed first foraging activity respectively at about 0700, 0700, and between 0530 and 0600 during good weather. In rainy weather, however, *T. mosquito* did not appear until about 0800, and this species and *T. jatay* were not seen to initiate foraging at all during thunderstorms.

By contrast von Ihering (1903) reported that *T. schrottkyi* Friese, occurring in Brazil, did not open its nest entrance until between 0800 and 1000, even in fair weather. Additionally Lutz (1931) cites eight first flights for *T.* (*Plebeia*) *mosquito* variety *domiciliorum* Schwarz on Barro Colorado Island, Canal Zone, all of which occurred relatively late in the morning. Lutz concluded that opening of the nest and initiation of foraging activity occur in response to both light conditions and to a circadian clock mechanism. The observations of Lutz were made in November and December; near the end of the rainy season in the canal zone. This condition perhaps explains the apparent contradiction between his observations for *T. mosquito* and those of Peckolt, who worked in the dry season in Brazil.

The activity pattern recorded in the present study for *T. fulviventris* (Peak activity in the mornings and evenings; moderate activity at midday) is similar to activity patterns observed by Peckolt (1894) for two stingless bee species which he identified as *T. mosquito* and *T. bipunctata.* However, foraging activity reportedly lasted only until about 1500 or 1600, normally, for those bees; not until nearly dusk as was the situation with *T. fulviventris* in the present study.

A different foraging pattern is reported by Peckolt for *T. jatay*, and Ducke (1901) for *T. fuscipennis* Friese (later considered to be *T. cupira F. Smith*) and for *T.* (*Plebeia*) *goeldiana* Friese. These species were observed to do the majority of their foraging from early morning until about noon, to cease flight activity during the heat of midafternoon, and to once again initiate foraging toward evening. Peckolt observed the latter flight period of *T. jatay* to last from about 1500 until about 1800.

The nest of *T. fulviventris fulviventris* in the present study seems similar in structure and location to those described for *T. fulviventris fulviventris* by Michener (1946, p. 189). There was no association with a termite nest, as has been reported for the subspecies *guianae.* Similar to the experience of Michener (1946) in studying the species in Panama, *T. fulviventris* in the present study were very gentle and not easily excitable, continuing apparently normal activity during close and prolonged observation at the nest site. Threat of attack was not observed.

SUMMARY.—Observations were made at and around a nest of *Trigona fulviventris* from 8 through 12 March 1969, on the Osa Peninsula, Puntarenas Province, Costa Rica. Foraging activity of *T. fulviventris* began before light, declined in intensity throughout the morning hours to a stable level maintained through midday, and then increased to a

second peak before dark. Foraging ended abruptly after the evening activity peak. The foraging pattern of *T. fulviventris* in the present study is similar to that of some other *Trigona* species, but still other *Trigona* species terminate foraging completely during midday. Early foraging activity appears to be characteristic of many species of *Trigona,* including *T. fulviventris,* but this behavior apparently is altered by inclement weather in some species, and at least one species, *T. schrottkyi,* characteristically opens its nest tube late in the morning, even in fair weather.

Trigona fulviventris failed to forage at feeders baited with honey solution and placed at varying distances and directions from the nest. Failure in the species to forage near to the nest is also reported by Schwarz (1948). A unique "hovering" flight, not seen in other *Trigona* species in the study area, was observed for *T. fulviventris.*

Acknowledgements.—Critical evaluation of this manuscript by Drs. Robbin Thorp, Norman Gary, and William Hamilton III is gratefully acknowledged. I am also indebted to Dr. Alvaro Wille, Universidad de Costa Rica, for identification of specimens. The present study was conducted while attending the Organization of Tropical Studies fundamentals course in Costa Rica.

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